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The formation of Alkaloids in Plants.—Professor W. H. Dunstan has been indicating to the chemists' assistants of London the proper direction and method of pursuing the investigation of the above subject. The experimental studies of the pure chemist have shown the series of re-actions by which we may pass from starch through carbo-hydrate to organic acid, and thence to alkaloid. In the case of malic acid our knowledge is exceptionally extended, the series of intermediate compounds being almost completely established, and its relations to certain alkaloids very clearly pointed out. These steps being thus shown to be probable, it remains for the pharmacist to complete the evidence by actually detecting the indicated intermediate compounds in the plants. Those interested will find in the Pharmaceutical Record for April 15th, an excellent report of the lecture, taken from the British and Colonial Druggist.

H. H. R.

The Botanical Section of the Academy of Natural Sciences of Philadelphia has organized a series of field excursions similar to those of the Club. On July 4th the trip is to May's Landing, N. J., leaving Market Street at 8 A.M., and on July 11th to Cape May, leaving at 7 A.M. Mr. Martindale will direct the party. We wish our neighbors all success and pleasure in these trips to an extremely interesting region. All interested in botany are cordially invited to join.

Reviews of Foreign Literature.

Die Wechselbeziehung zwischen Pflanzen und Ameisen im tropischen Amerika. A. F. W. Schimper. Jena. Gustav Fischer, 1888.

This is the title of an article forming the first part of a collection of botanical notes from the tropics. The author believes to have discovered some interesting facts in reference to certain relations between animals and plants, by which both are benefited. He states that everywhere in tropical America, in woods or gardens, the traveler is surprised by seeing lines of moving leaf fragments, which are found to be carried by a procession of ants. A similar line of ants may be found traveling in the opposite direction to certain trees and shrubs where they cut out pieces of leaves, some as large as our cent piece, and carry them away, presumably to use them in the construction of their dwellings. This species of ant is named leaf-cutter and is known to be the greatest enemy to vegetation in the tropics. It chooses, for the most part, plants not indigenous to the country. From this fact the author sees a result of natural selection, as only such plants could continue to live and flourish which were not visited by these destructive ants.

There are many other species of ants found there, among which is a kind extremely hostile to the leaf-cutters. It is found that wherever these ants have taken possession of a tree, the leaf-cutters are driven away or hindered from attacking the tree, and the result is a flourishing growth, while those trees lacking this protection are injured and stunted by the destruction of their leaves.

It has long been known that certain plants in the tropics were inhabited by ants, and the idea entertained that a mutual benefit was thereby attained. The previous observations lacked definite proof, but those more recently made by Schimper he believes are of such a nature as to furnish conclusive proof of this theory. He found that a certain species of *Cecropia* was generally inhabited by ants extremely hostile, not only to their leaf-cutting neighbors, but to any other disturber of their habitation. A sharp stroke given to the tree was sufficient to call out a large number of these ants, whose bite was extremely poisonous, and the person rash enough to venture this experiment was glad to escape.

Fritz Müller describes the manner of the development of these ant colonies as follows: The ant who is to become queen mother of the colony bores or eats her way into the hollow stem of the tree. The opening thus made is shortly afterward closed up by the growth of the surrounding tissues, and not only this, but there is a farther development of abnormal tissue at this place, which is filled with a nourishing sap for the food of the ant. She lays her eggs in the cavity of the stem, from which are hatched the working ants, who soon open another communication with the outer world.

Schimper found that the trees containing these ants were never disturbed by the leaf-cutters, while other trees of the same species (*Cecropia adenopus*), but free from these ants, were visited regularly by the leaf-cutting ants and their leaves cut into fragments and destroyed. From this fact he drew two inferences: first, that the *Cecropia* was a favorite of the leaf-cutters; second, that the tree protected itself from their assaults by special adaptation to the wants of the protecting ants. A close examination of the anatomy of the tree confirmed the latter inference, showing a most curious and wonderful contrivance to favor the entrance of the protecting ants. The tree itself has been compared to a huge candelabrum, the limbs growing out horizontally at first, afterward bending sharply upward with few, but large leaves. It was found that the queen mother entered the hollow limb always at at a certain place. This was through a little depression at the top of the internode. This depression originates first from pressure of the axillary bud; when this is grown out and the pressure thus removed, the outer walls of the depression, instead of increasing in thickness like the ordinary outer walls, remain thin and soft, no hardening takes place, the membrane remaining in this condition till after the entrance of the ant has been effected, when the before described abnormal growth takes place. Another species was found to lack these colonies of protecting ants, but in their stead was provided with a wax coating on the outside cells so smooth as to effectually hinder the leaf-cutting ants from reaching the leaves. Now in these trees the same depression is caused by pressure of the axillary bud in the first stages of its growth, but when the pressure is removed the subsequent development of the thin-lined cavity entirely fails. The ordinary thickening processes take place, and no chance is left for the entrance of the protecting ants.

Still another difference was discovered between these two species, which Schimper also regards as an adaptation to the needs of the protecting ants. On those *Cecropia* trees on which they were found, under the petiole of the leaf just at its basis, the surface, for the space of a square centimeter, is covered with velvety hairs. On similar trees, lacking these ants, the same clusters of hairs are found, but on their surface little egg-shaped bodies loosely connected with the hairs. Fritz Müller was the first to suggest the probable use of these bodies, that is, to serve as food for the protecting ants. Schimper found by experimenting that the bodies were constantly reproduced, so furnishing daily food. On cutting through the cushion of hairs the little egg-like bodies were found in all stages of development. Also, by removing the outer leaves of buds on those trees where the ants were living, the bodies were found in abundance and were seized upon and eaten with great avidity by the ants.

These egg-shaped bodies were found to consist largely of albuminous matter and essential oil, substances which are not otherwise given off by plants, except in case of seeds. So rich an offering of plant-production without some corresponding use is hardly credible, therefore Schimper concludes that these are built up by the plant specially to maintain the colonies of ants without whose protection it would be unable to reach any degree of perfection.

Another tree possessing similar features is a species of *Acacia.* Here the ants make their homes in the large hollow thorns. Food is also provided for them, in the shape of similar bodies of an albuminous nature, which occur in peculiar organs on the tips of the leaves. Still other plants are described as possessing similar remarkable examples of adaptation.

In the third chapter of this article, the author treats of the so-called extra-nuptial glands, that is, those not situated in the immediate vicinity of the reproductive organs, whose use, therefore, cannot be to attract insects as aids to fertilization. The so-called Belt-Delpino hypothesis regarding their use was confirmed by his experiments. That is, that these organs serve as a means of attraction to those insects, which, in their turn, protect the plant from insects which are more injurious, in fact fatal to its growth and full development. He found that nearly all the plants supplied with these glands were visited by ants, and, in several cases, was able to prove directly that they afforded protection against the leaf-cutting species. It is difficult to find any other use the plant can make of the honey so secreted; that it is not a waste product, whose retention might injure the plant, was shown by separating the glands from the plant, and it was found to thrive equally well as those whose glands were left intact. A considerable amount of honey was found secreted by these glands, as by carefully removing it the process of secretion was found to be kept up for several weeks. He proved also that the honey was a product of the single leaf to which the gland belonged. By darkening the leaf no honey was secreted. It is also said that these organs are much more common among the tropical plants than among those in the temperate zones, all of which facts go to make probable the theory of plant adaptation to its surroundings. E. L. G.

Peculiar Properties of Adhatoda vasica, Nees.—One of the most interesting, and, as it may also prove, important of recent investigations of plant properties is described by Mr. David Hooper, Government Quinologist in India, in the Pharmaceutical Journal and Transactions of April 7, and is in relation to the Acanthaceous shrub *Adhatoda vasica*, Nees. The leaves, which are variously used as a domestic drug and dye, are chiefly interesting on account of their use in agriculture. Great injury is inflicted on the rice crop of India by the masses of Algæ and other aquatics which infest the partially submerged grounds. It was noticed by Dr. G. Watt that the natives protected themselves against these enemies by casting into the water large quantities of the *Adhatoda* leaves. This observation led Mr. Hooper to undertake the examination of the plant. He succeeded in isolating a peculiar acid which he called adhatodic acid, and an alkaloid which he called vasicine, the adhatodate of vasicine being regarded as the active principle of the leaves.

"A sample of pond-water containing *Spirogyra* and numerous animalcules was mixed with a strong infusion of *Adhatoda* leaves. The chlorophyll gradually disappeared from the weeds, and the cells became broken up. The oxygen was given off with less frequency, and at length ceased. Some insect pupæ rose to the surface of the water and there died. Numerous *Paramecia* remained active for some time, but eventually succumbed to the action of the poison. In twenty-four hours the beaker containing the water showed only a brown mass lying at the bottom, while some water in a beaker at the side, without this treatment, contained the green aquatic weeds evolving oxygen, and the animalcules alive."

Farther experiments upon insect vermin, and upon frogs, promptly produced poisonous effects. But upon the higher animals, no such effect resulted.

Some of the results recorded seem very strange as compared with others, and we shall verify and extend the experiments as soon as a supply of the leaves can be obtained. Should it be found that their destructive effect extends to the lowest forms of vegetable life, it may prove that we at last have an agent of defense against not only insect pests and parasitical diseases of plants, but against some of the sporadic human diseases.

H. H. R.

Index to Recent American Botanical Literature.

Amelanchier alnifolia, Nutt.—S. Watson. (Garden and Forest, i., 185, fig. 34.)

Anthurium Chamberlaini, Mast. n. sp. (Gard. Chron., iii., 462, fig. 67.) This is a new species from Venezuela.

Asimina triloba. (Garden, xxxiii., 321, illustrated.)

Bald Cypress.—How it converts Lakes into Forests.—A. H. Curtiss. (Garden and Forest, i., 123.)

Brodiœa Bridgesii.—Sereno Watson. (Garden and Forest, i., 125, fig. 24.)

Bulletin from the Botanical Department of the State Agricultural College, Ames, Iowa.—Byron D. Halsted. (Pamph., 8vo. pp. 118, four plates, 1888.)

This second of Professor Halsted's bulletins contains detailed accounts of the work accomplished at Ames in 1887. Some of the papers have appeared in other publications. Among those here first printed we note "Preliminary List of the Weeds of Iowa," containing 297 species ; "Oil glands on the Anthers of Cucurbitaceous Plants," "Observations on *Oxalis*" a study of dimorphism in the common species, "Notes on Pollen" of numerous plants, "A Provisional List of Fungi," a "List of California Parasitic Fungi," observed by Professor Halsted, and numerous short notes of interest and importance.

Calycanthus floridus and *C. occidentalis.* (Garden, xxxiii, 392, illustrated.)

Camassia Cusickii.—Sereno Watson. (Garden and Forest, i., 172, fig. 32.)